Continuous Glucose Monitor (CGM) Use Ameliorates the Negative Effects of Fear of Hypoglycemia on Sleep Duration and Sleep Disturbances in Adolescents with Type I Diabetes

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Introduction

- Youth with Type 1 Diabetes (T1D) have increased sleep disturbances and reduced sleep duration compared to the general population.[1]
- Fear of hypoglycemia (FOH) has been associated with poor sleep quality in adults with T1D.[2]. Less is known about the effects of FOH on sleep in adolescents with T1D.
- Youth with T1D have reported the benefits of CGM use on sleep in qualitative studies, yet this relationship has not been proven.[3]

Objectives

1. To examine the association between adolescent FOH and sleep parameters
2. To assess if CGM use influences these relationships

Methods

Cross-sectional study of Adolescents with T1D

- Inclusion criteria: Adolescents 14-18 years, Type 1 Diabetes diagnosis > 1 year, and positive diabetes autoantibody (anti-GAD, anti-IA2, anti-insulin or anti-ZnT8)
- **Questionnaires**:
  1. Fear of hypoglycemia (Children's Hypoglycemia Fear Survey, C-HFS)[4]
     - Comprised of two sub-scales: Worry and Behavior
  2. Sleep parameters (Pittsburgh Sleep Quality Index, PSQI)[5]
- Clinical data collected at diabetes clinic visit closest to survey collection:
  - Hemoglobin A1c, glucometer, insulin pump and CGM data
- **Analyses**: Univariate linear regression and Student's t-tests

Results

- 100 adolescents were enrolled in this study (Tables 1 & 2).
- **Increased FOH** is associated with **Reduced Sleep Duration** (R^2 = 0.06, **p=0.01**) (Figure 1).
  - With stratified analysis on CGM use, **this relationship was only significant for those NOT using CGM** (r2=0.09, **p =0.03**)
- **Increased FOH** is associated with **Reduced Sleep Quality** (R^2 = 0.05, **p=0.03**) (Figure 2).
- **Increased FOH** is associated with **Increased Sleep Disturbances** (R^2 = 0.06, **p=0.01**) (Figure 3).
  - With stratified analysis on CGM use, **this relationship was only significant for those NOT using CGM** (r2=0.1, **p =0.02**)
- **Average Sleep Duration** is **longer for those with meaningful use of CGM** (>50% of the time) compared to those without CGM use (**p=0.02**) (Figure 4).

Table 1: Demographics

Trait	Number
Sample Size	100
Female	56
CGM Use >50%	45
With Insulin Pump	63
Private Insurance	79
Race/ethnicity*	
Non-Hispanic White	66
Non-Hispanic Black	26
Hispanic	6
Other	4

Table 2: Participant Characteristics

Participant Trait	Mean (SD)
Age, years	16.5 (1.4)
Duration of T1D, years	6.4 (3.9)
Hemoglobin A1c, %	8.9 (2.2)
BMI, Z-score	0.88 (0.88)
Sleep Duration, hours	7.1 (1.6)
Sleep Disturbance Score (Range 0-3, 3=high disturbance)	1.0 (0.57)
Sleep Quality Score (Range 0-21, 21 = worse sleep quality)	6.9 (4.7)

Figure 1. FOH (Predictor) and Sleep Duration (Outcome)

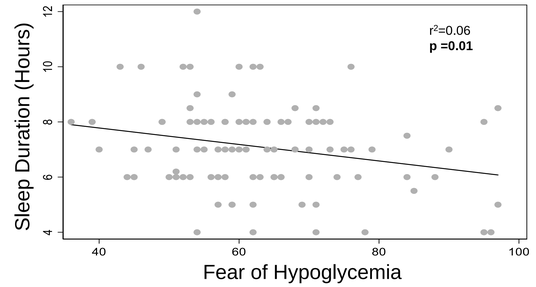


Figure 2. FOH (Predictor) and Sleep Quality (Outcome)

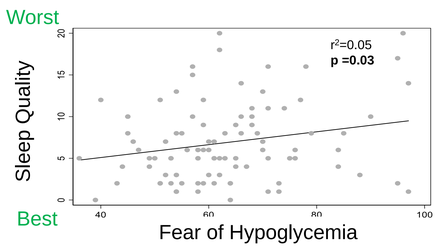


Figure 3. FOH (Predictor) and Sleep Disturbance (Outcome)

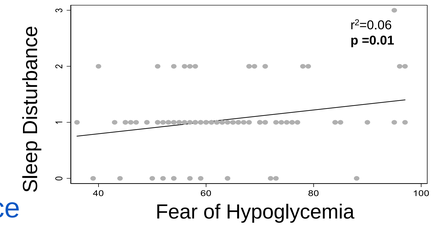
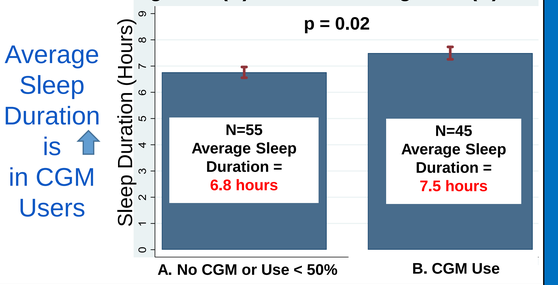


Figure 4. Mean (SEM) Sleep Duration (hours) in those not using CGM (A) and those using CGM (B)



Conclusions

- In adolescents with T1D, **increased fear of hypoglycemia is associated with worse sleep outcomes** including:
  - Reduced sleep duration
  - Reduced sleep quality
  - Increased sleep disturbances
- Pediatric T1D clinics should assess for fear of hypoglycemia and its impact on sleep
  - Youth with T1D affected by fear of hypoglycemia may benefit from interventions targeting both fear of hypoglycemia and its effect on sleep
- **CGM device use appears to be protective** against the negative consequences of fear of hypoglycemia on sleep
  - Those with meaningful CGM use no longer have an association between fear of hypoglycemia and sleep duration or sleep disturbances
  - Average sleep duration is higher in those with CGM use

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